The Bi-annual Pitot Static Check *by Tom Martin*

Based on CAR 605.35, if we fly in transponder required airspace the owners of amateur built aircraft are by law supposed to get their pitot/static/transponder/encoder check done bi-annually. I recently had this testing done by Kitchener Aero, Kitchener, Ontario. I have dealt with this company numerous times over the years and this time I asked if they would mind if I took a few pictures and asked for some basic information regarding what they actually look for.

There is some pretty sophisticated equipment used for this testing (High end RVSM and XPDR test sets can typically cost around $50,000 and $20,000 respectively + $1,500 in annual calibration costs). The first thing that happens is that the altimeter is removed from the aircraft and bench tested to make sure that it meets certain criteria. It was tested from -1000 feet to 20,000 feet (in accordance with CAR Standard 571 Appendix F). There is an allowance for error of a +/- 20 feet at lower altitudes to +/- 130 feet at 20,000 feet. The instrument is also checked for case leaks, hysteresis, after effects, barometric scale error, and for friction lag. It was interesting to watch the needle climb as a vacuum was applied. It is not a real smooth motion and this is due to internal friction. The technician actually tapped on the case lightly to simulate engine and airplane vibrations. Apparently my altimeter was very good and had negligible errors. This was a mid to low priced unit and is six years old.

The verified altimeter is reinstalled in the aircraft and the pitot and static sources are plumbed to an expensive piece of equipment that will test the system in place. The pitot-static test set applies a vacuum to simulate a slow climb, 1000 feet per minute and compares what it says the altitude is compared with what the altimeter and the transponder read out. In my case I have an Advanced Flight Systems 4500 EFFIS and we were able to initially show that it was reading about 30 feet low. The nice thing about an EFFIS, at least this one, is that making

adjustments to errors is quite easy. Now that the EFFIS and my altimeter were reading the same number, the test continued. The transponder and encoder itself is checked (in accordance with CAR Standard 571 Appendix F) with another piece of equipment that tests the antennae, that the unit has adequate power, it is operating in the correct frequency range, has the ability to reply to the tower and also to check the ident button. As the encoder only reads in 100 foot increments it is also important to note were it changes to the next level. This should occur as it passes each 50-foot mark. For example, as it was passing 3550 feet the encoder should change from 3500 to 3600 feet. At 14,800 feet, a CARS required test level, the rate of climb is stopped and the error between what the altimeters and the transponder are showing, with what the level actually is, are recorded.

Above, opposite: the removed altimeter being bench tested. Here, the testing equipment is connected to the pitot static system of the airplane.

The allowed error at this level is +/- 125 feet. This is as high as the testing is required to meet the regulations but I occasionally fly higher and thus the system was tested to at least the maximum operating altitude of the aircraft.

My airspeed system was also checked for errors and had a small error at lower airspeeds but at my cruise speeds of 200 knots it was quite accurate. It is important to note that all of these tests are done on the ground and if you have static errors that occur due to flight conditions this can introduce significant error. Determining static system errors in flight could be an entire separate article. Kevin Horton, Ottawa, has an excellent website, http://www.kilohotel.com/rv8/index.php

Check the flight test links for more information on this issue.

The whole process can be done in a couple of hours if there are no problems encountered with the system. While I was there another aircraft was tested and the transponder failed the Appendix F test requirements. This unit appeared to be working properly and had not been flagged by the operator or the tower as being in error. In this case the transponder was removed from the aircraft and the staff was able to reset it in their avionics shop.

As amateur built owners we often have panel equipment that is not certified, as is the case with my EFFIS. Typically certified avionics are required to pass certain tests and are then labeled "TSO'd". Basically this means that they have been tested for various conditions and have been proven to behave in a predictable fashion. My EFFIS has a built in encoder but as the unit is not TSO'd it falls into a grey area in the regulations. Apparently it is legal to use non-TSO'd equipment but we have to be able to prove that it functions to the same standards as does the certified versions. In the case of encoders Kitchener Aero, my shop, is unaware of any facilities in Canada that would perform TSO certification of a third party's encoder. It might be possible to find a shop that would sign out the equipment but they would be pushing the limits of the regulations. Thus I have a separate TSO'd Sandia encoder, mounted in the aircraft. Interestingly, the altimeter itself does not necessarily have to be TSO'd equipment. I would suspect this is because it is quite a simple piece of equipment and is also easy to test in shops for accuracy.

If there are no problems you can expect to pay around $410 for this bi-annual check and if there are problems then you should be relieved that they were found, especially if you fly in controlled airspace. I find this to be an interesting exercise as it also provides a bi-annual review of the systems and how they work together.

Tom Martin *is the builder of an EVO Rocket, races it on a regular basis and knows a lot about making airplanes go fast.*